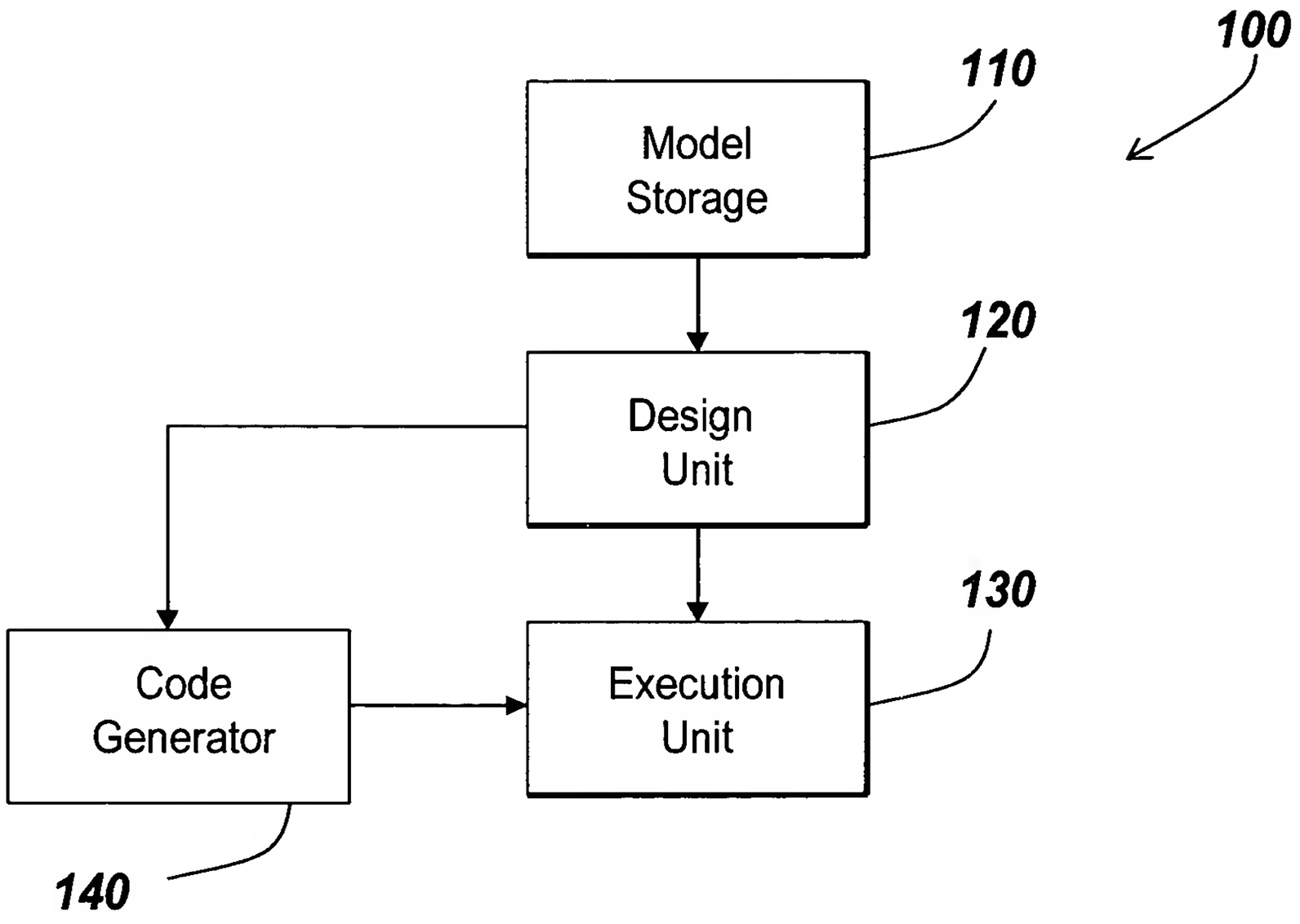
100
110
Model Storage
120
Design Unit
130
Execution Unit
Code Generator
140

Fig. 1A

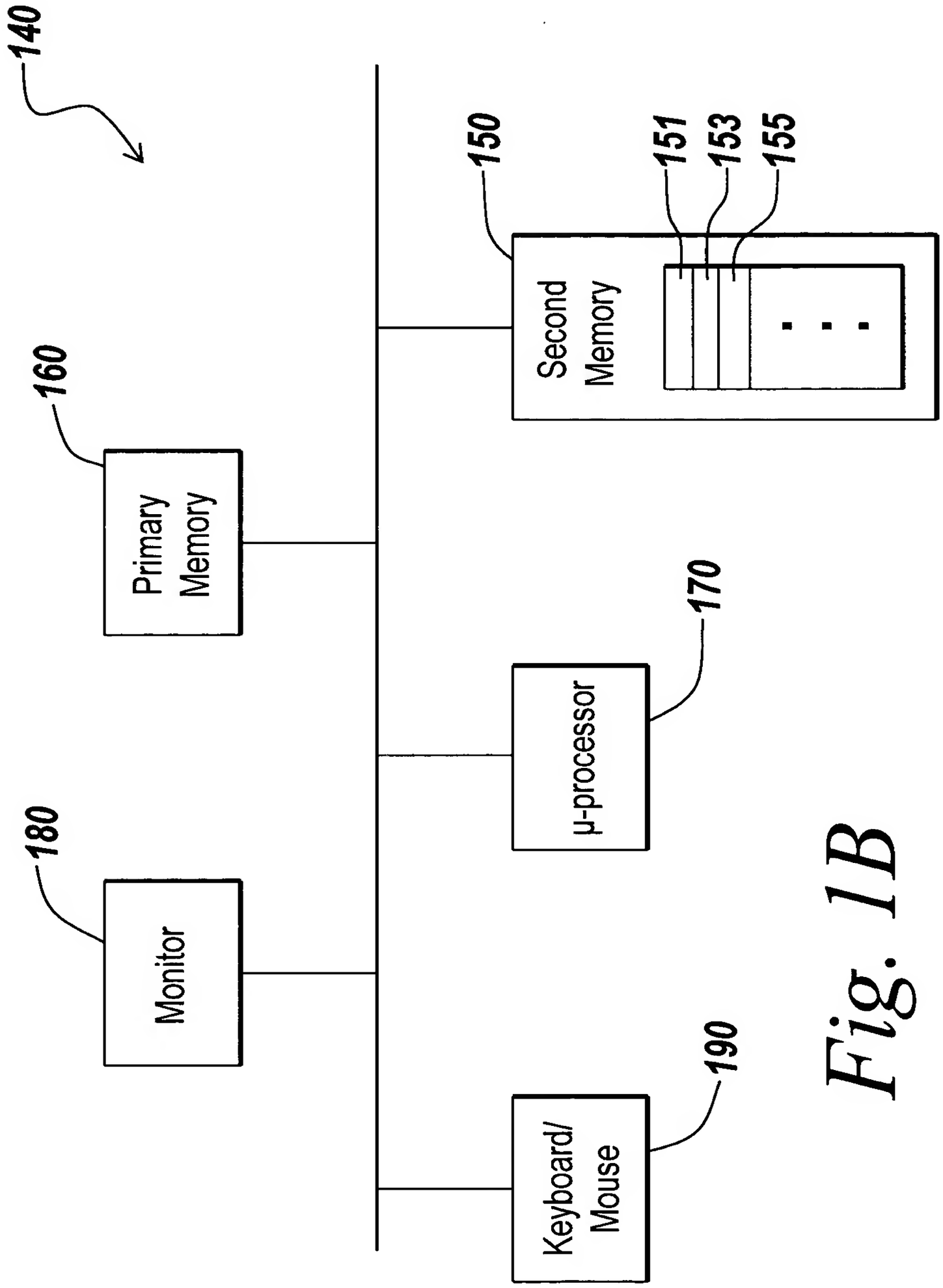
140
150
151
153
155
Second Memory
160
Primary Memory
170
µ-processor
180
Monitor
190
Keyboard/ Mouse

Fig. 1B

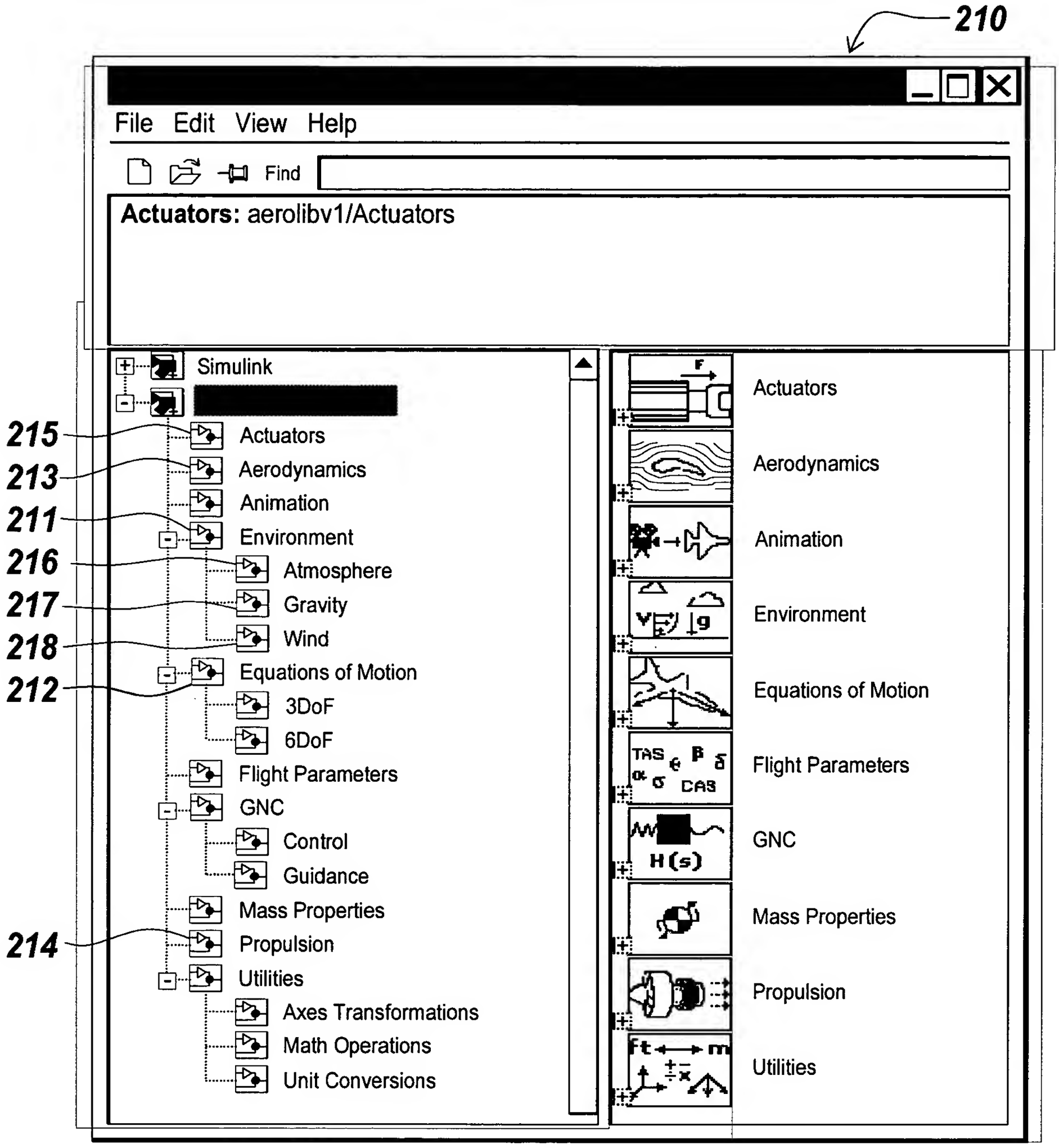
210
File Edit View Help
Find
Actuators: aerolibv1/Actuators
Simulink
215
Actuators
213
Aerodynamics
Animation
211
Environment
216
Atmosphere
217
Gravity
218
Wind
212
Equations of Motion
3DoF
6DoF
Flight Parameters
GNC
Control
Guidance
Mass Properties
214
Propulsion
Utilities
Axes Transformations
Math Operations
Unit Conversions
Actuators
Aerodynamics
Animation
Environment
Equations of Motion
Flight Parameters
GNC
Mass Properties
Propulsion
Utilities

Fig. 2A

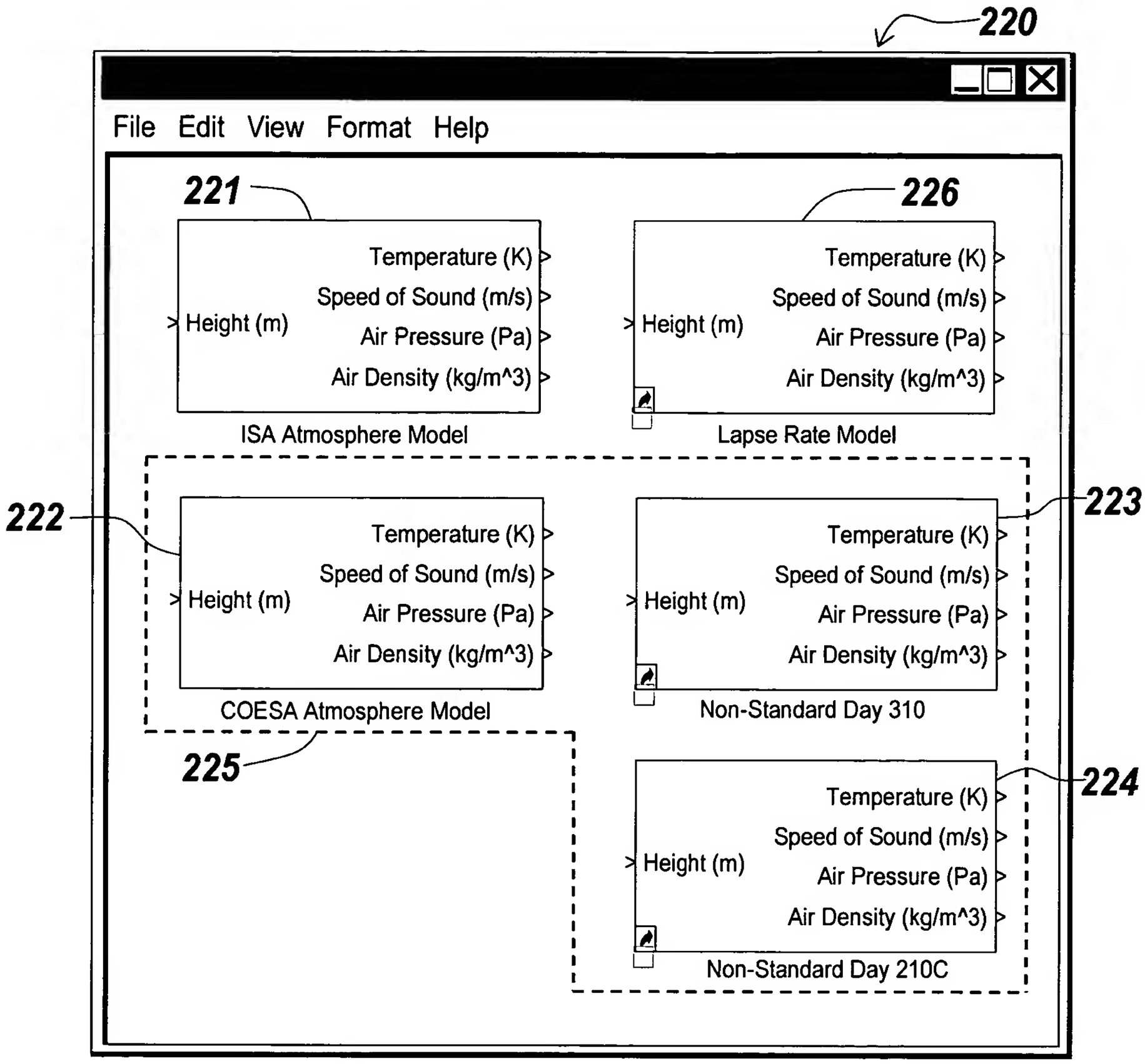
220
File Edit View Format Help
221
Height (m)
Temperature (K)
Speed of Sound (m/s)
Air Pressure (Pa)
Air Density (kg/m^3)
ISA Atmosphere Model
226
Height (m)
Temperature (K)
Speed of Sound (m/s)
Air Pressure (Pa)
Air Density (kg/m^3)
Lapse Rate Model
222
Height (m)
Temperature (K)
Speed of Sound (m/s)
Air Pressure (Pa)
Air Density (kg/m^3)
COESA Atmosphere Model
223
Height (m)
Temperature (K)
Speed of Sound (m/s)
Air Pressure (Pa)
Air Density (kg/m^3)
Non-Standard Day 310
225
224
Height (m)
Temperature (K)
Speed of Sound (m/s)
Air Pressure (Pa)
Air Density (kg/m^3)
Non-Standard Day 210C

Fig. 2B

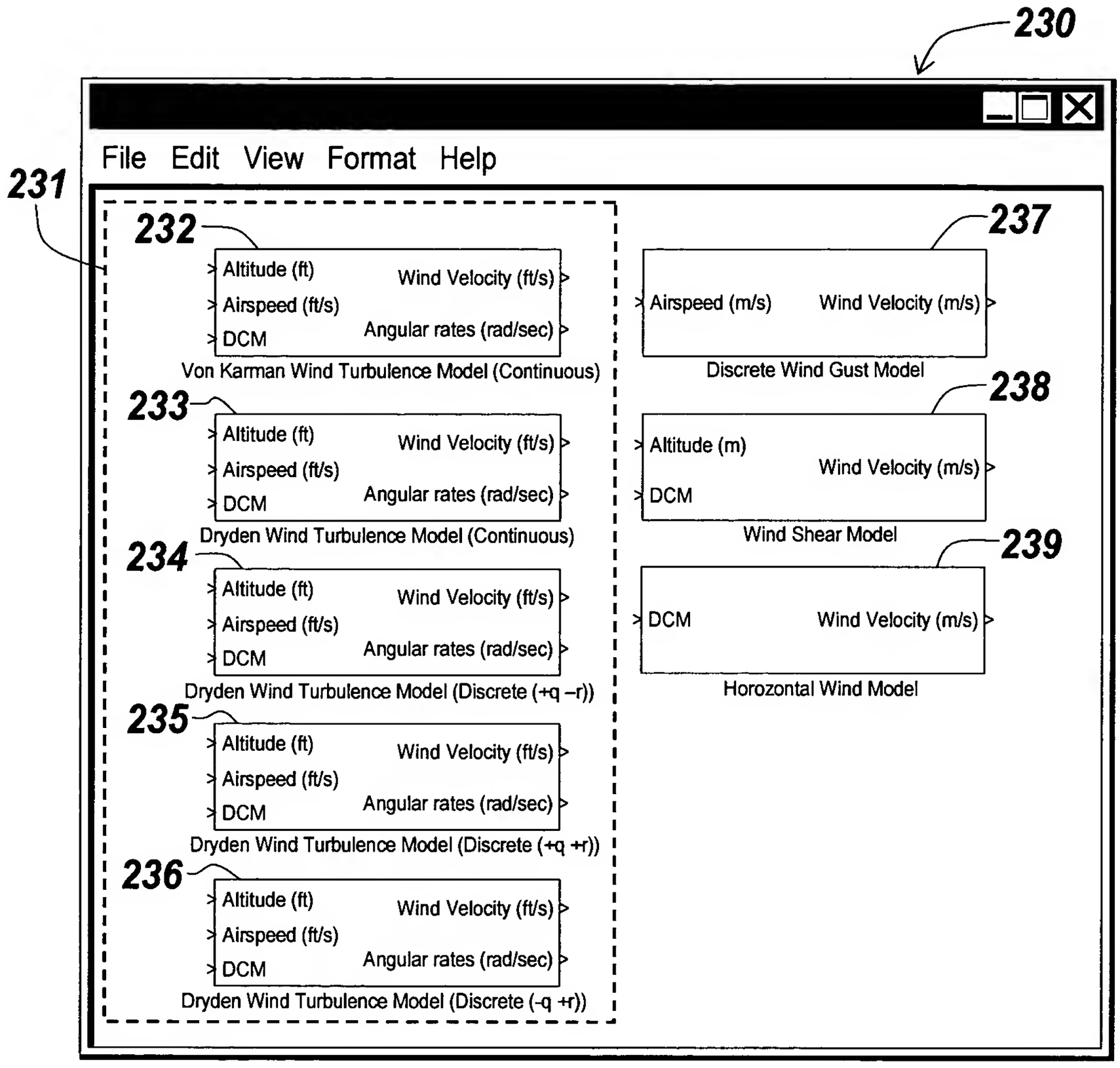
230
File Edit View Format Help
231
232
Altitude (ft)
Airspeed (ft/s)
DCM
Wind Velocity (ft/s)
Angular rates (rad/sec)
Von Karman Wind Turbulence Model (Continuous)
233
Altitude (ft)
Airspeed (ft/s)
DCM
Wind Velocity (ft/s)
Angular rates (rad/sec)
Dryden Wind Turbulence Model (Continuous)
234
Altitude (ft)
Airspeed (ft/s)
DCM
Wind Velocity (ft/s)
Angular rates (rad/sec)
Dryden Wind Turbulence Model (Discrete (+q –r))
235
Altitude (ft)
Airspeed (ft/s)
DCM
Wind Velocity (ft/s)
Angular rates (rad/sec)
Dryden Wind Turbulence Model (Discrete (+q +r))
236
Altitude (ft)
Airspeed (ft/s)
DCM
Wind Velocity (ft/s)
Angular rates (rad/sec)
Dryden Wind Turbulence Model (Discrete (-q +r))
237
Airspeed (m/s)
Wind Velocity (m/s)
Discrete Wind Gust Model
238
Altitude (m)
DCM
Wind Velocity (m/s)
Wind Shear Model
239
DCM
Wind Velocity (m/s)
Horozontal Wind Model

Fig. 2C

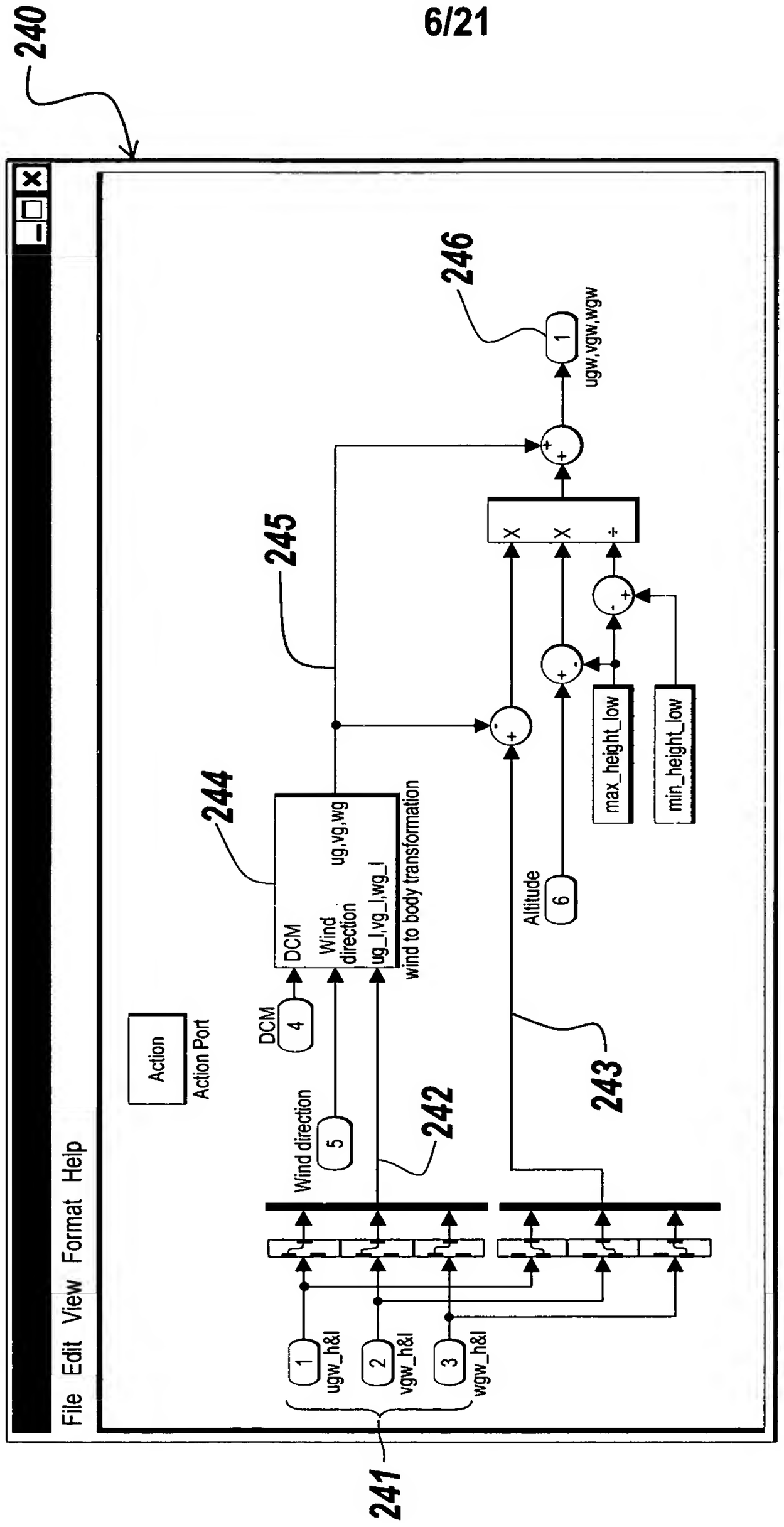
240
File Edit View Format Help
246
ugw,vgw,wgw
1
245
244
DCM
Wind direction
ug_l,vg_l,wg_l
wind to body transformation
ug,vg,wg
Action
Action Port
DCM
4
Wind direction
5
242
Altitude
6
243
max_height_low
min_height_low
ugw_h&l
vgw_h&l
wgw_h&l
241

Fig. 2D

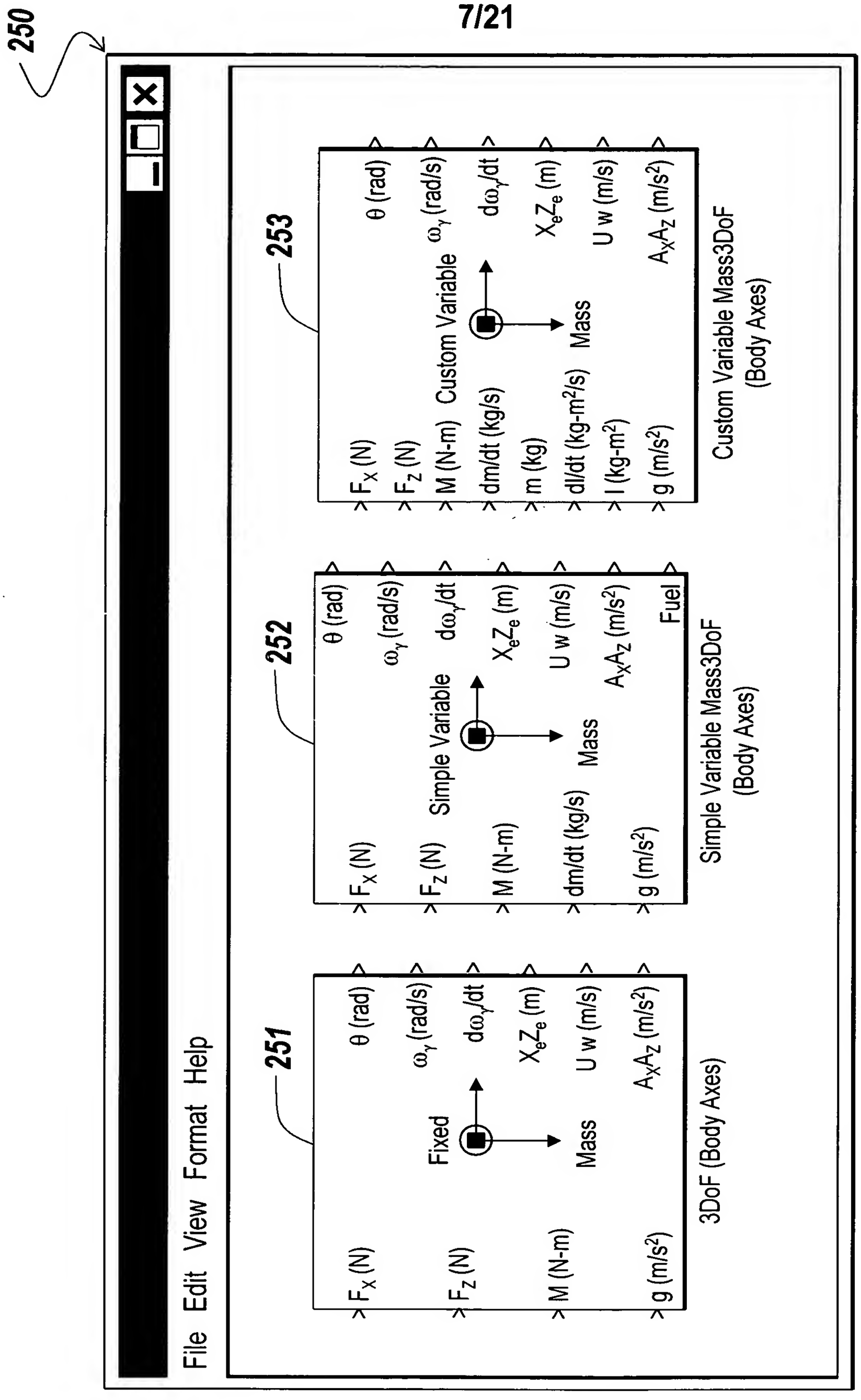
250
File Edit View Format Help
253
θ (rad)
ωγ (rad/s)
dωγ/dt
XeZe (m)
U w (m/s)
AXAZ (m/s2)
Custom Variable
Mass
Variable Mass3DoF
(Body Axes)
FX (N)
FZ (N)
M (N-m)
Custom Variable
dm/dt (kg/s)
m (kg)
dI/dt (kg-m2/s)
I (kg-m2)
g (m/s2)
Custom Variable Mass3DoF
(Body Axes)
252
θ (rad)
ωγ (rad/s)
dωγ/dt
XeZe (m)
U w (m/s)
AXAZ (m/s2)
Fuel
FX (N)
FZ (N)
M (N-m)
Simple Variable
Mass
dm/dt (kg/s)
g (m/s2)
Simple Variable Mass3DoF
(Body Axes)
251
θ (rad)
ωγ (rad/s)
dωγ/dt
XeZe (m)
U w (m/s)
AXAZ (m/s2)
FX (N)
FZ (N)
M (N-m)
Fixed
Mass
g (m/s2)
3DoF (Body Axes)

Fig. 2E

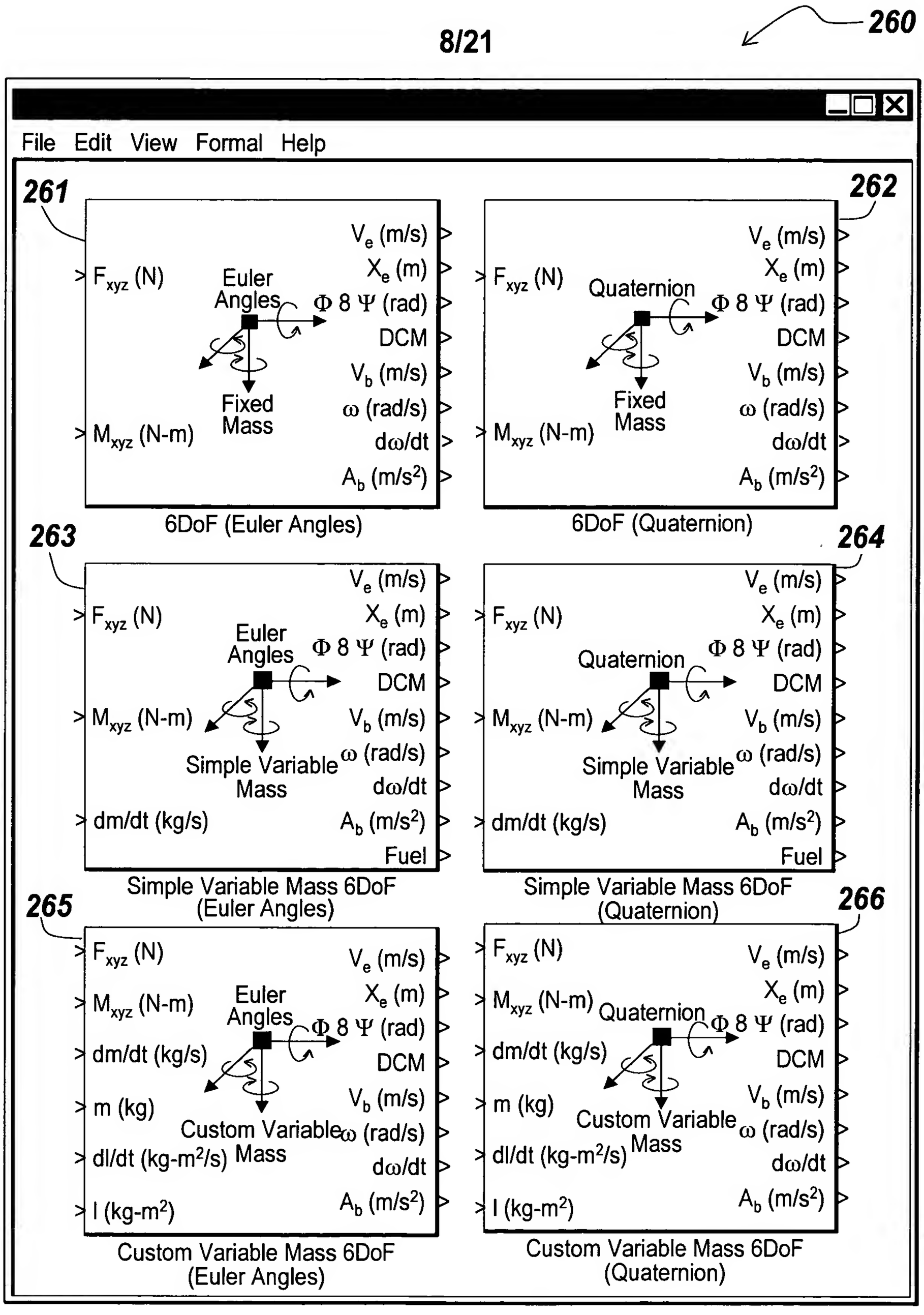
260
File Edit View Formal Help
261
V_e (m/s)
X_e (m)
F_{xyz} (N)
Euler Angles
Φ 8 Ψ (rad)
DCM
V_b (m/s)
Fixed Mass
ω (rad/s)
M_{xyz} (N-m)
dω/dt
A_b (m/s²)
6DoF (Euler Angles)
262
V_e (m/s)
X_e (m)
F_{xyz} (N)
Quaternion
Φ 8 Ψ (rad)
DCM
V_b (m/s)
Fixed Mass
ω (rad/s)
M_{xyz} (N-m)
dω/dt
A_b (m/s²)
6DoF (Quaternion)
263
V_e (m/s)
X_e (m)
F_{xyz} (N)
Euler Angles
Φ 8 Ψ (rad)
DCM
M_{xyz} (N-m)
V_b (m/s)
Simple Variable Mass
ω (rad/s)
dω/dt
dm/dt (kg/s)
A_b (m/s²)
Fuel
Simple Variable Mass 6DoF (Euler Angles)
264
V_e (m/s)
X_e (m)
F_{xyz} (N)
Quaternion
Φ 8 Ψ (rad)
DCM
M_{xyz} (N-m)
V_b (m/s)
Simple Variable Mass
ω (rad/s)
dω/dt
dm/dt (kg/s)
A_b (m/s²)
Fuel
Simple Variable Mass 6DoF (Quaternion)
265
F_{xyz} (N)
V_e (m/s)
X_e (m)
M_{xyz} (N-m)
Euler Angles
Φ 8 Ψ (rad)
dm/dt (kg/s)
DCM
V_b (m/s)
m (kg)
Custom Variable Mass
ω (rad/s)
dω/dt
dI/dt (kg-m²/s)
A_b (m/s²)
I (kg-m²)
Custom Variable Mass 6DoF (Euler Angles)
266
F_{xyz} (N)
V_e (m/s)
X_e (m)
M_{xyz} (N-m)
Quaternion
Φ 8 Ψ (rad)
dm/dt (kg/s)
DCM
V_b (m/s)
m (kg)
Custom Variable Mass
ω (rad/s)
dω/dt
dI/dt (kg-m²/s)
A_b (m/s²)
I (kg-m²)
Custom Variable Mass 6DoF (Quaternion)

Fig. 2F

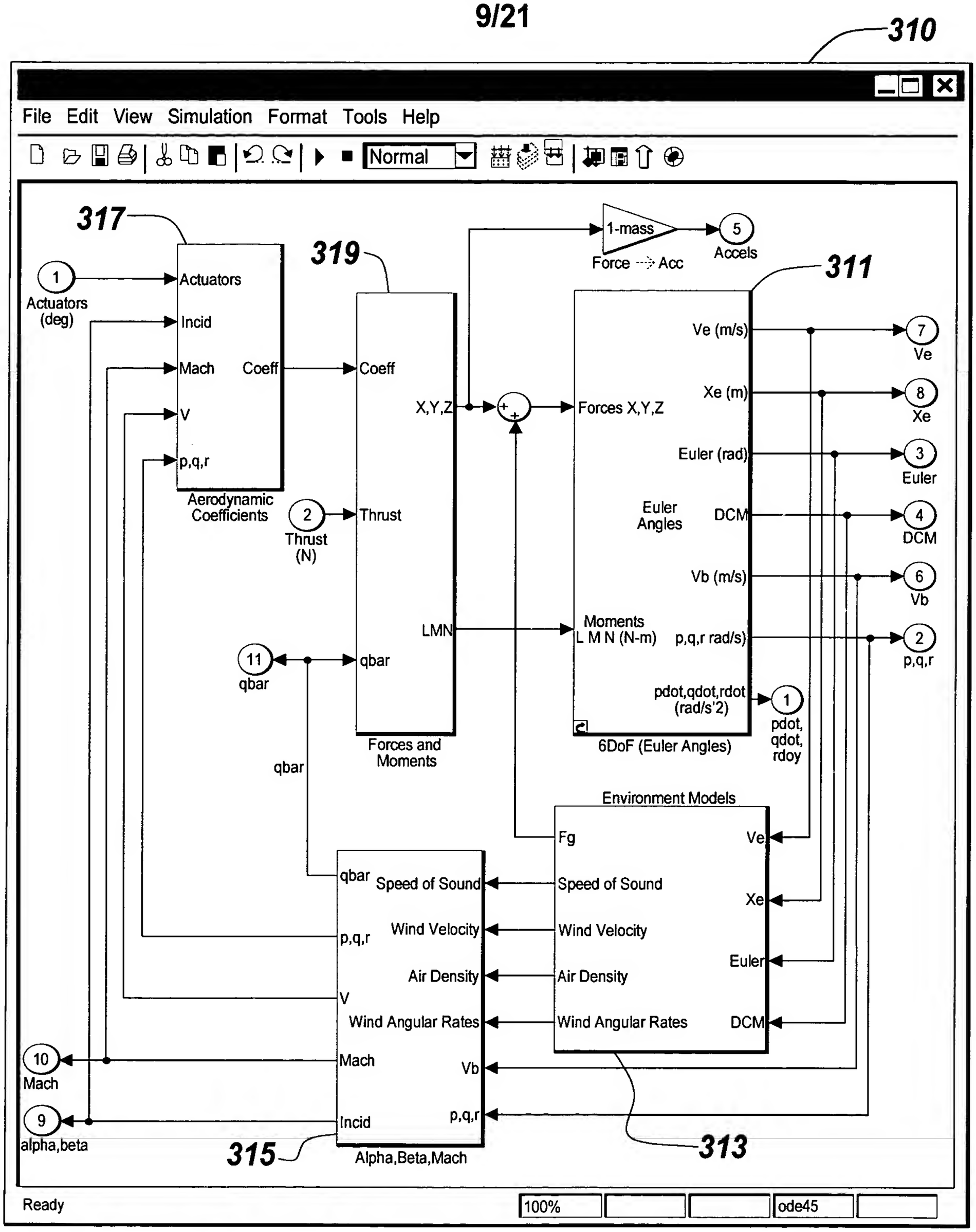
310
File Edit View Simulation Format Tools Help
Normal
317
319
311
1
Actuators
(deg)
Actuators
Incid
Mach
Coeff
V
p,q,r
Aerodynamic
Coefficients
2
Thrust
(N)
Thrust
Coeff
1-mass
Force → Acc
5
Accels
X,Y,Z
Forces X,Y,Z
Ve (m/s)
7
Ve
Xe (m)
8
Xe
Euler (rad)
3
Euler
Euler
Angles
DCM
4
DCM
Vb (m/s)
6
Vb
LMN
Moments
L M N (N-m)
p,q,r rad/s)
2
p,q,r
11
qbar
qbar
Forces and
Moments
pdot,qdot,rdot
(rad/s'2)
1
pdot,
qdot,
rdoy
6DoF (Euler Angles)
Environment Models
Fg
Ve
Xe
Euler
DCM
qbar
Speed of Sound
p,q,r
Wind Velocity
Air Density
V
Wind Angular Rates
Mach
Vb
Incid
p,q,r
10
Mach
9
alpha,beta
315
Alpha,Beta,Mach
313
Ready
100%
ode45

Fig. 3A

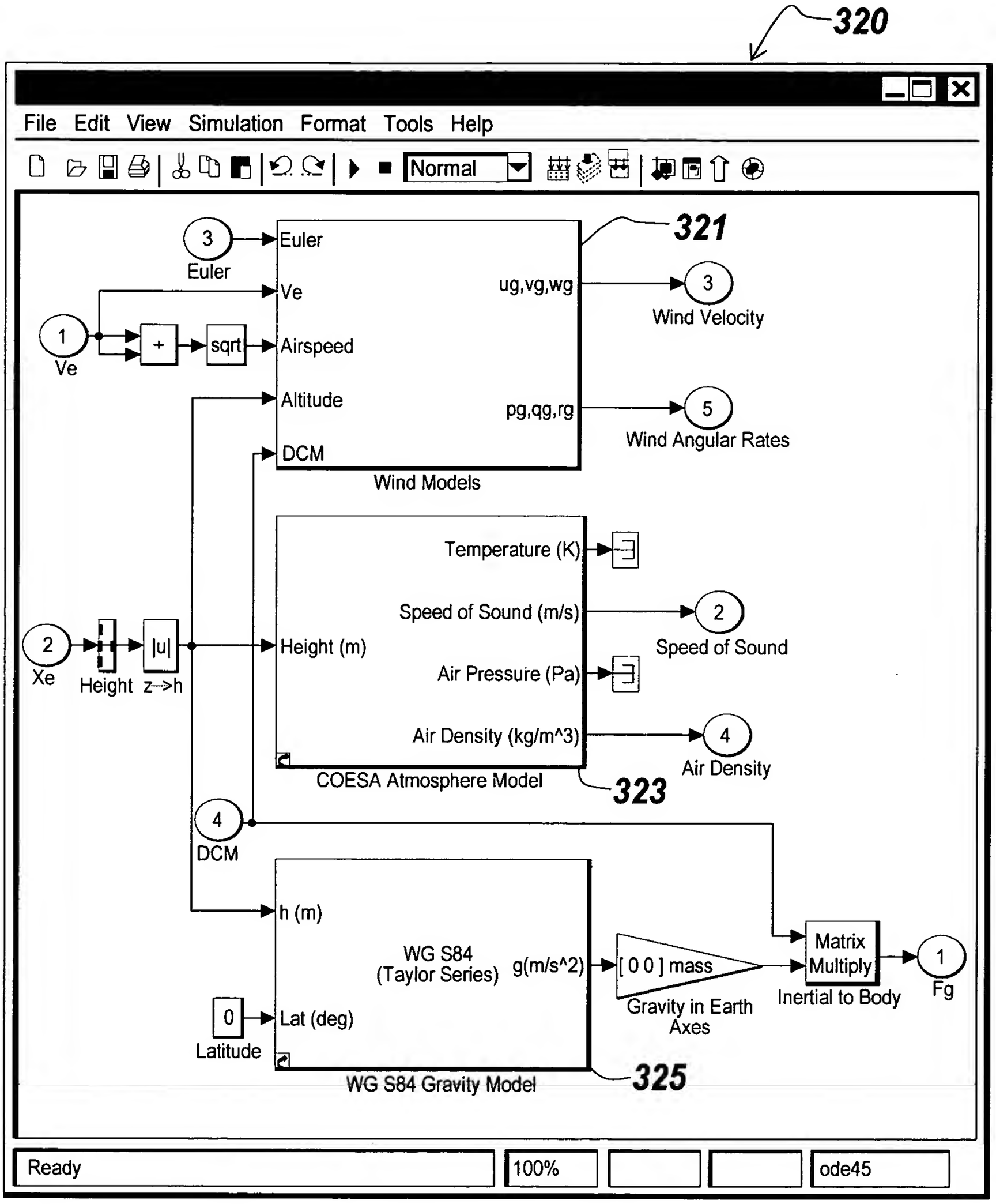
320
File Edit View Simulation Format Tools Help
Normal
3
Euler
Euler
Ve
1
Ve
+
sqrt
Airspeed
Altitude
DCM
Wind Models
321
ug,vg,wg
3
Wind Velocity
pg,qg,rg
5
Wind Angular Rates
Temperature (K)
Speed of Sound (m/s)
2
Speed of Sound
Height (m)
Air Pressure (Pa)
Air Density (kg/m^3)
4
Air Density
COESA Atmosphere Model
323
2
Xe
Height
|u|
z->h
4
DCM
h (m)
WG S84
(Taylor Series)
g(m/s^2)
[0 0] mass
Gravity in Earth
Axes
Matrix
Multiply
Inertial to Body
1
Fg
0
Latitude
Lat (deg)
WG S84 Gravity Model
325
Ready
100%
ode45

Fig. 3B

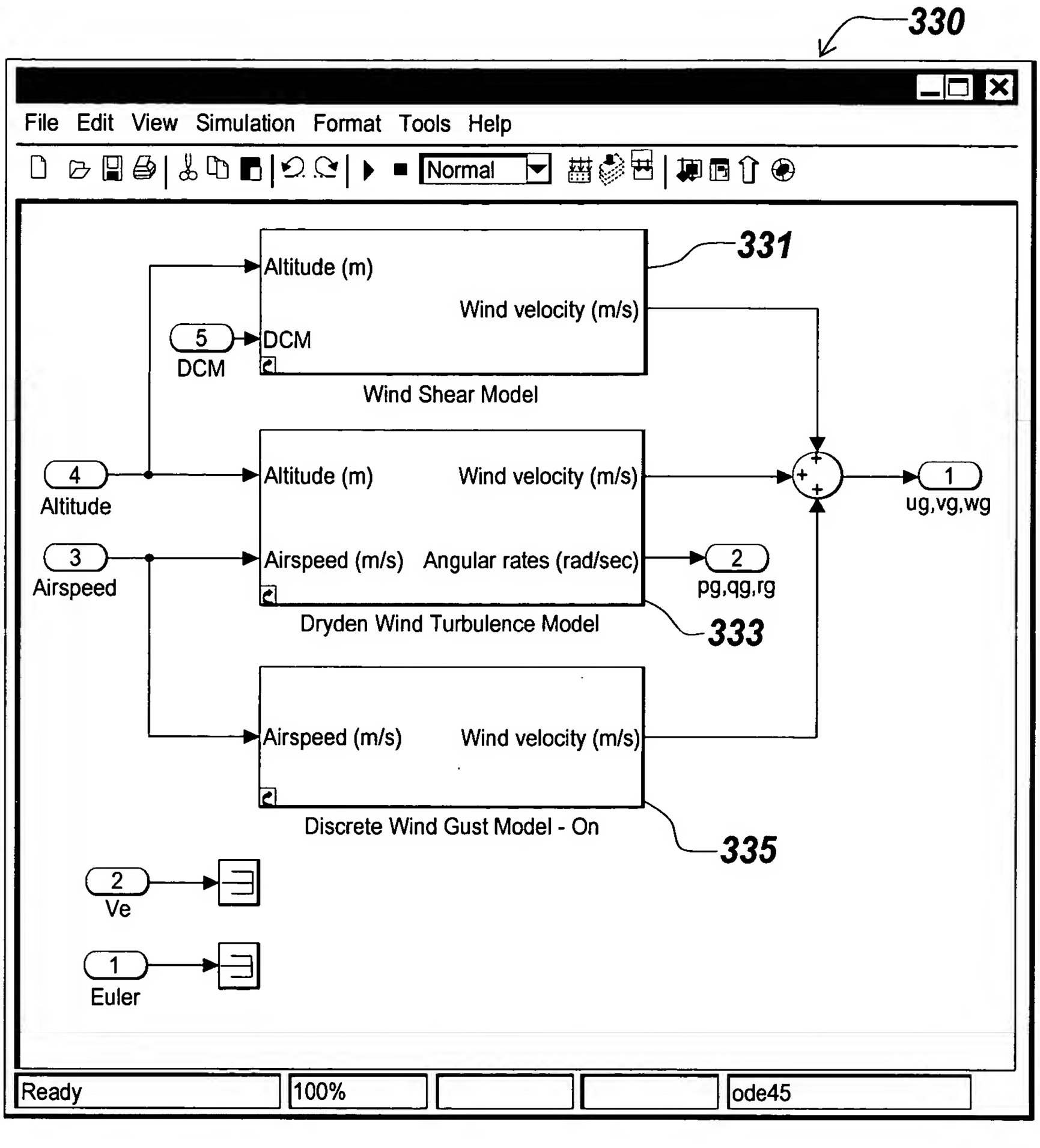
330
File Edit View Simulation Format Tools Help
Normal
331
Altitude (m)
Wind velocity (m/s)
5
DCM
DCM
Wind Shear Model
4
Altitude
Altitude (m)
Wind velocity (m/s)
3
Airspeed
Airspeed (m/s)
Angular rates (rad/sec)
2
pg,qg,rg
Dryden Wind Turbulence Model
333
1
ug,vg,wg
Airspeed (m/s)
Wind velocity (m/s)
Discrete Wind Gust Model - On
335
2
Ve
1
Euler
Ready
100%
ode45

Fig. 3C

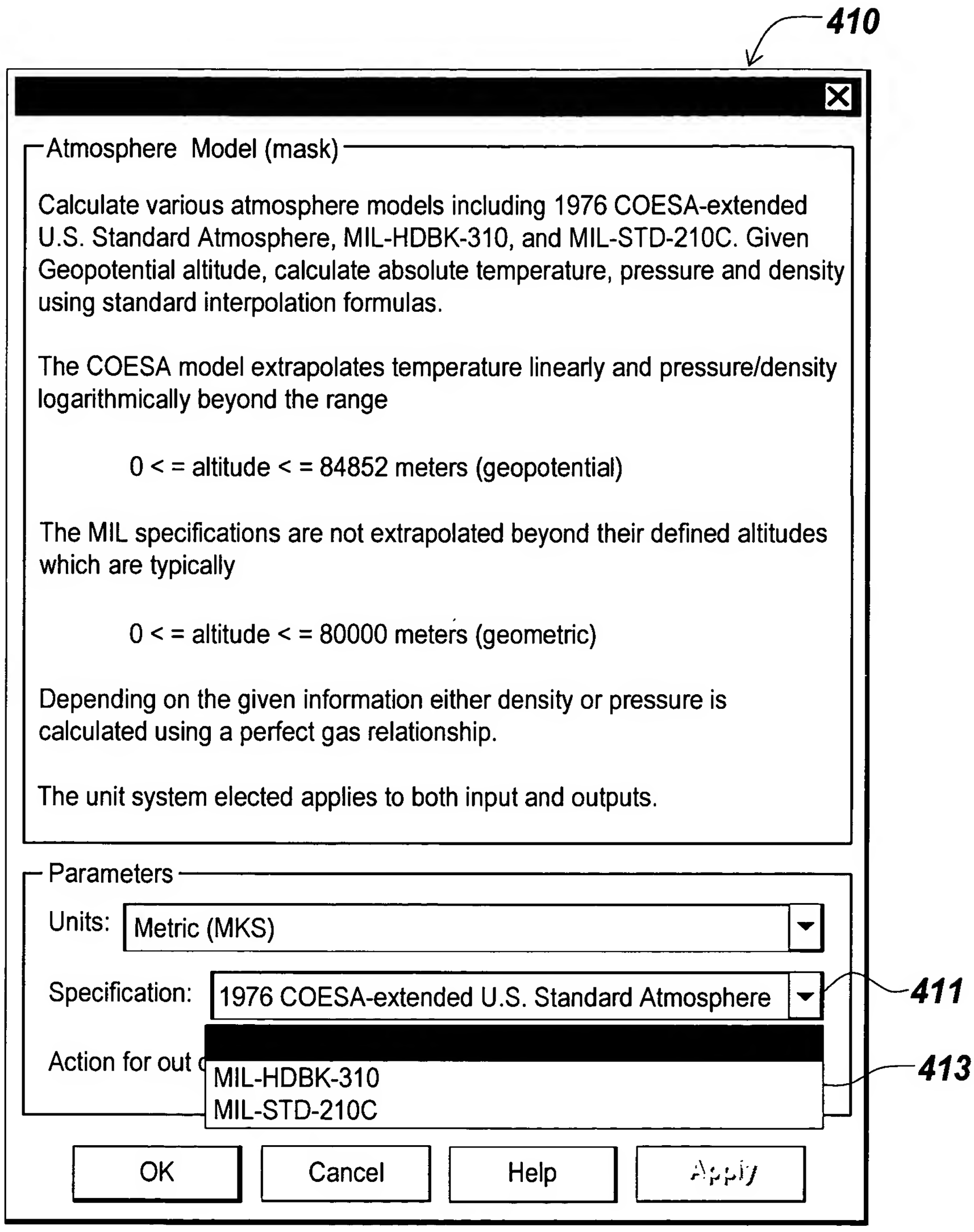
410
Atmosphere Model (mask)
Calculate various atmosphere models including 1976 COESA-extended U.S. Standard Atmosphere, MIL-HDBK-310, and MIL-STD-210C. Given Geopotential altitude, calculate absolute temperature, pressure and density using standard interpolation formulas.
The COESA model extrapolates temperature linearly and pressure/density logarithmically beyond the range
0 < = altitude < = 84852 meters (geopotential)
The MIL specifications are not extrapolated beyond their defined altitudes which are typically
0 < = altitude < = 80000 meters (geometric)
Depending on the given information either density or pressure is calculated using a perfect gas relationship.
The unit system elected applies to both input and outputs.
Parameters
Units:
Metric (MKS)
Specification:
1976 COESA-extended U.S. Standard Atmosphere
411
Action for out
MIL-HDBK-310
MIL-STD-210C
413
OK
Cancel
Help
Apply

Fig. 4A

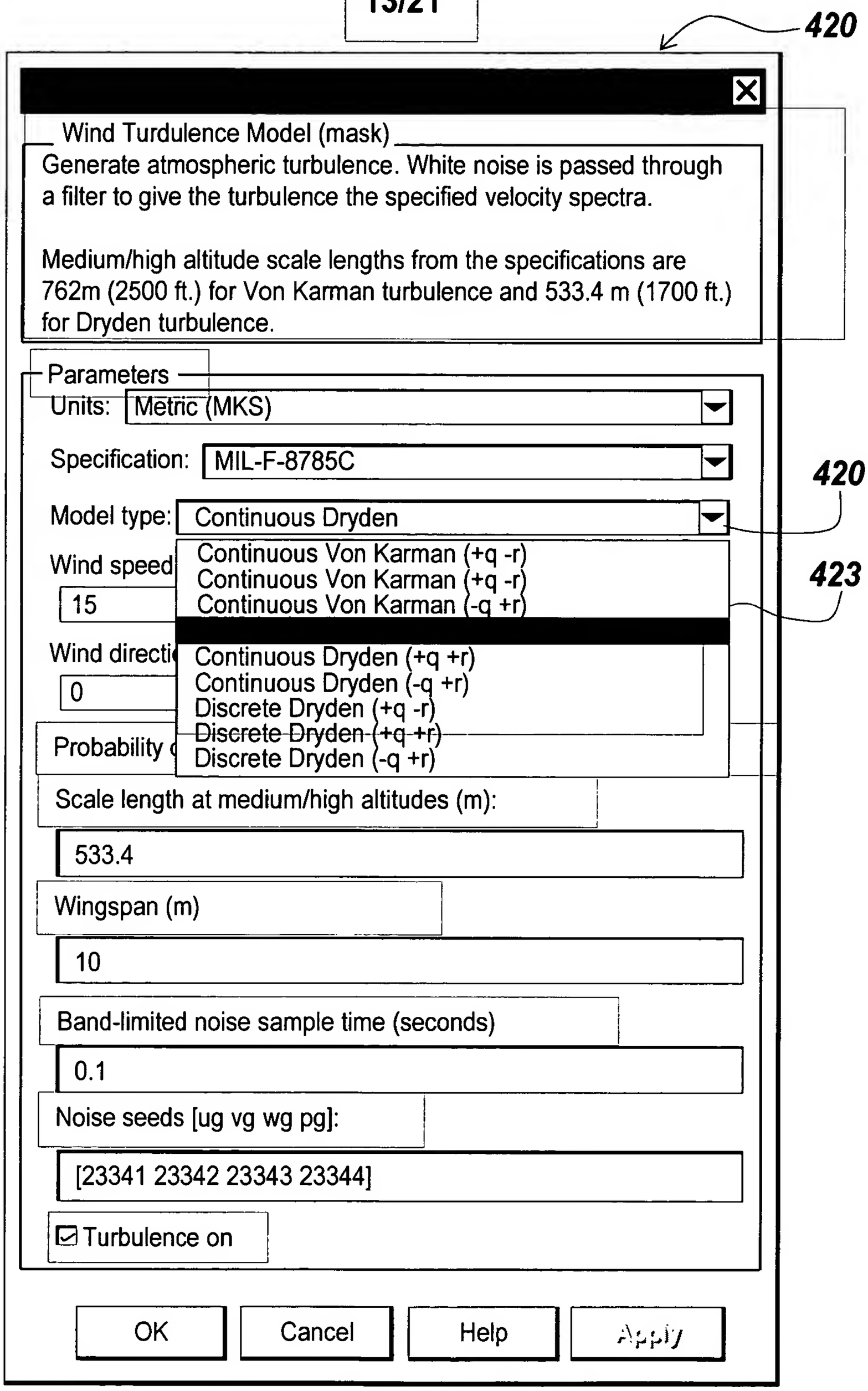
420
Wind Turdulence Model (mask)
Generate atmospheric turbulence. White noise is passed through a filter to give the turbulence the specified velocity spectra.
Medium/high altitude scale lengths from the specifications are 762m (2500 ft.) for Von Karman turbulence and 533.4 m (1700 ft.) for Dryden turbulence.
Parameters
Units: Metric (MKS)
Specification: MIL-F-8785C
Model type: Continuous Dryden
420
Continuous Von Karman (+q -r)
Continuous Von Karman (+q -r)
Continuous Von Karman (-q +r)
423
Continuous Dryden (+q +r)
Continuous Dryden (-q +r)
Discrete Dryden (+q -r)
Discrete Dryden (+q +r)
Discrete Dryden (-q +r)
Wind speed
15
Wind directi
0
Probability
Scale length at medium/high altitudes (m):
533.4
Wingspan (m)
10
Band-limited noise sample time (seconds)
0.1
Noise seeds [ug vg wg pg]:
[23341 23342 23343 23344]
Turbulence on
OK
Cancel
Help
Apply

Fig. 4B

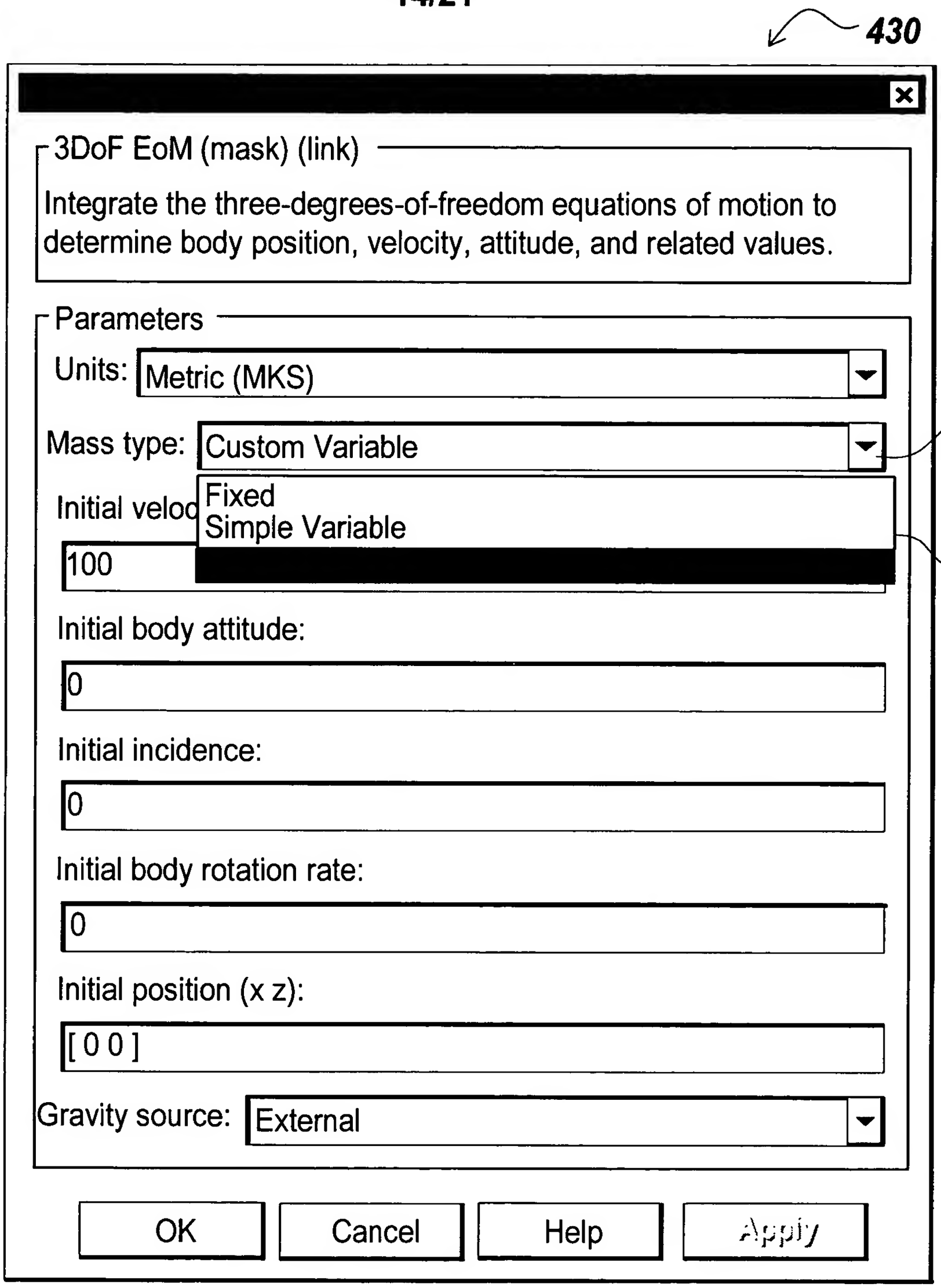
430
3DoF EoM (mask) (link)
Integrate the three-degrees-of-freedom equations of motion to determine body position, velocity, attitude, and related values.
Parameters
Units: Metric (MKS)
Mass type: Custom Variable
431
Fixed
Simple Variable
433
Initial velo
100
Initial body attitude:
0
Initial incidence:
0
Initial body rotation rate:
0
Initial position (x z):
[0 0]
Gravity source: External
OK
Cancel
Help
Apply

Fig. 4C

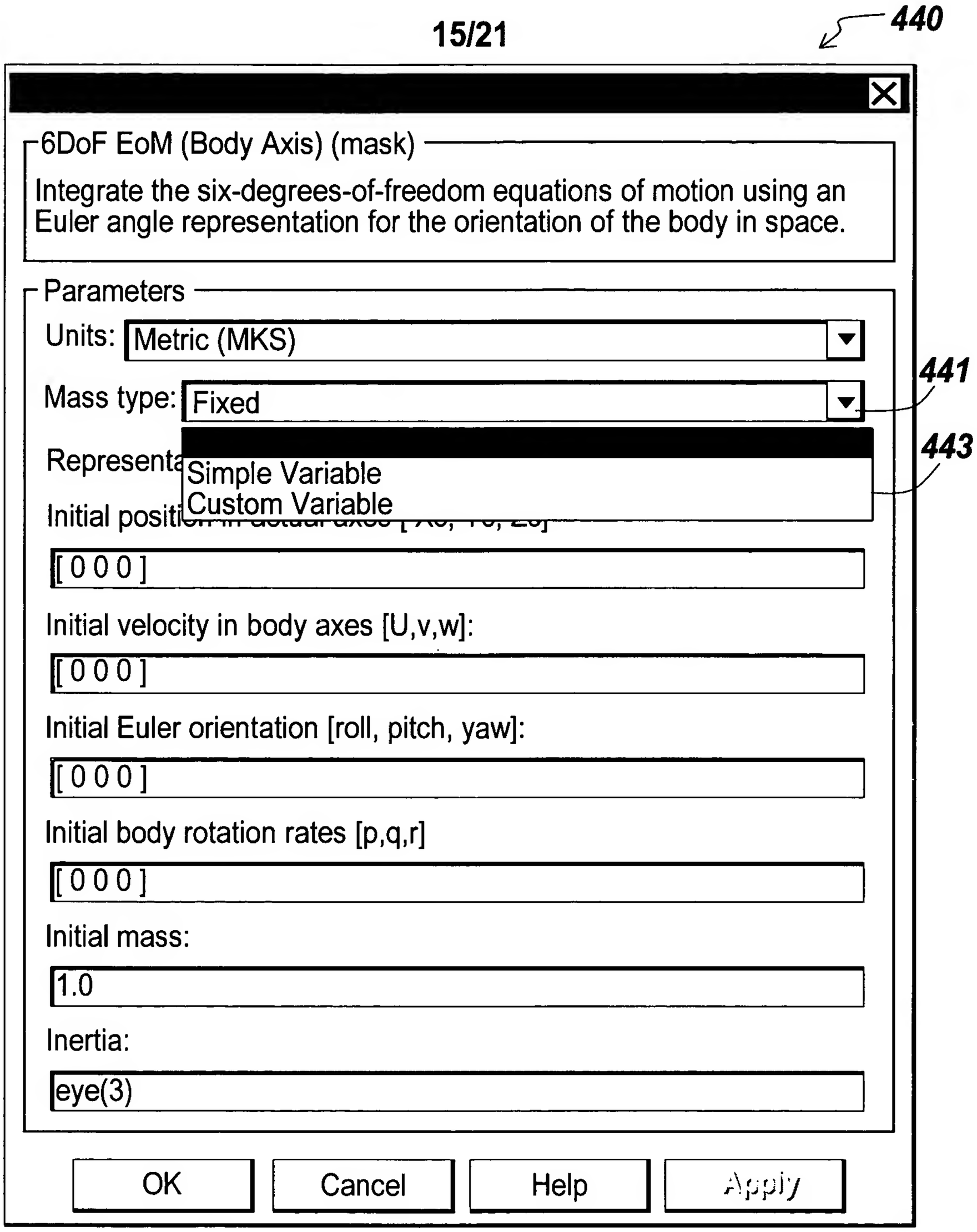
440
6DoF EoM (Body Axis) (mask)
Integrate the six-degrees-of-freedom equations of motion using an Euler angle representation for the orientation of the body in space.
Parameters
Units:
Metric (MKS)
Mass type:
Fixed
441
Simple Variable
Custom Variable
443
Initial position in actual axes [X0, Y0, Z0]
[0 0 0]
Initial velocity in body axes [U,v,w]:
[0 0 0]
Initial Euler orientation [roll, pitch, yaw]:
[0 0 0]
Initial body rotation rates [p,q,r]
[0 0 0]
Initial mass:
1.0
Inertia:
eye(3)
OK
Cancel
Help
Apply

Fig. 4D

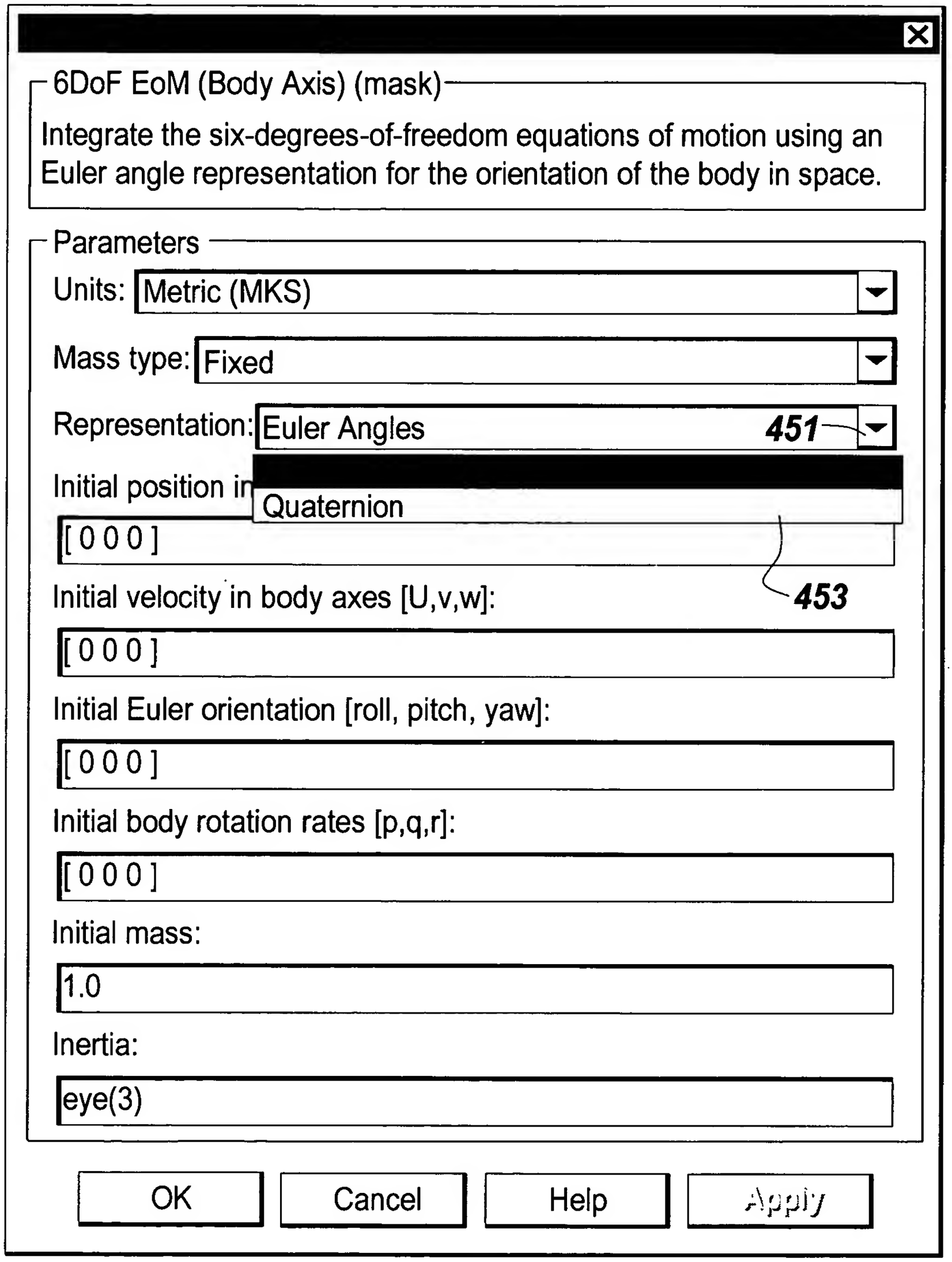
450
6DoF EoM (Body Axis) (mask)
Integrate the six-degrees-of-freedom equations of motion using an Euler angle representation for the orientation of the body in space.
Parameters
Units: Metric (MKS)
Mass type: Fixed
Representation: Euler Angles
451
Quaternion
Initial position in
[0 0 0]
453
Initial velocity in body axes [U,v,w]:
[0 0 0]
Initial Euler orientation [roll, pitch, yaw]:
[0 0 0]
Initial body rotation rates [p,q,r]:
[0 0 0]
Initial mass:
1.0
Inertia:
eye(3)
OK
Cancel
Help
Apply

Fig. 4E

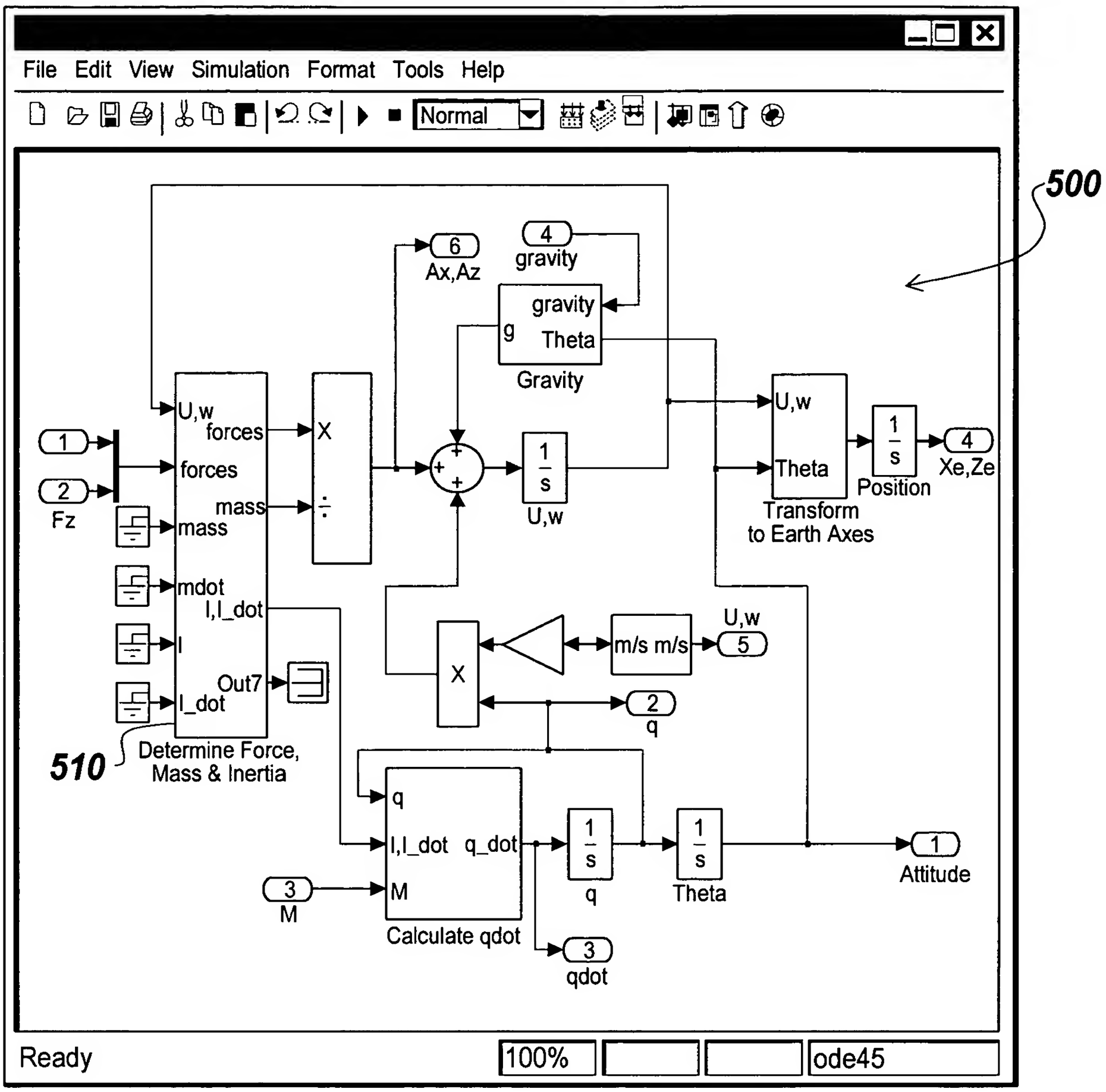
File Edit View Simulation Format Tools Help
Normal
500
6
Ax,Az
4
gravity
gravity
g
Theta
Gravity
U,w
forces
forces
mass
mass
mdot
I,I_dot
I
Out7
I_dot
X
÷
1
2
Fz
U,w
1/s
U,w
Theta
Transform
to Earth Axes
Position
4
Xe,Ze
510
Determine Force,
Mass & Inertia
X
m/s m/s
U,w
5
2
q
q
I,I_dot
q_dot
M
3
M
Calculate qdot
1/s
q
1/s
Theta
1
Attitude
3
qdot
Ready
100%
ode45

Fig. 5A

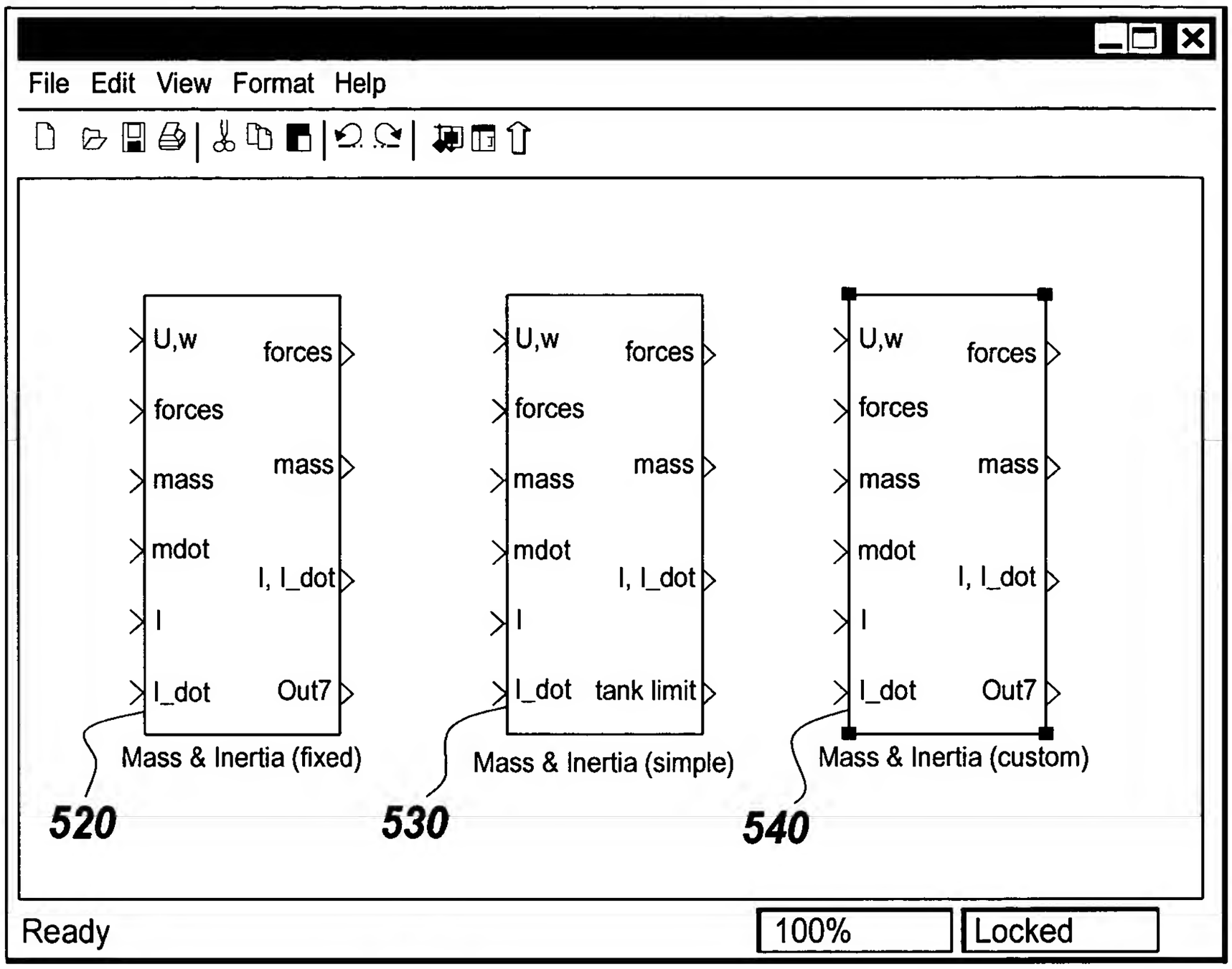
File Edit View Format Help
U,w
forces
mass
mdot
I
I_dot
forces
mass
I, I_dot
Out7
Mass & Inertia (fixed)
520
U,w
forces
mass
mdot
I
I_dot
forces
mass
I, I_dot
tank limit
Mass & Inertia (simple)
530
U,w
forces
mass
mdot
I
I_dot
forces
mass
I, I_dot
Out7
Mass & Inertia (custom)
540
Ready
100%
Locked

Fig. 5B

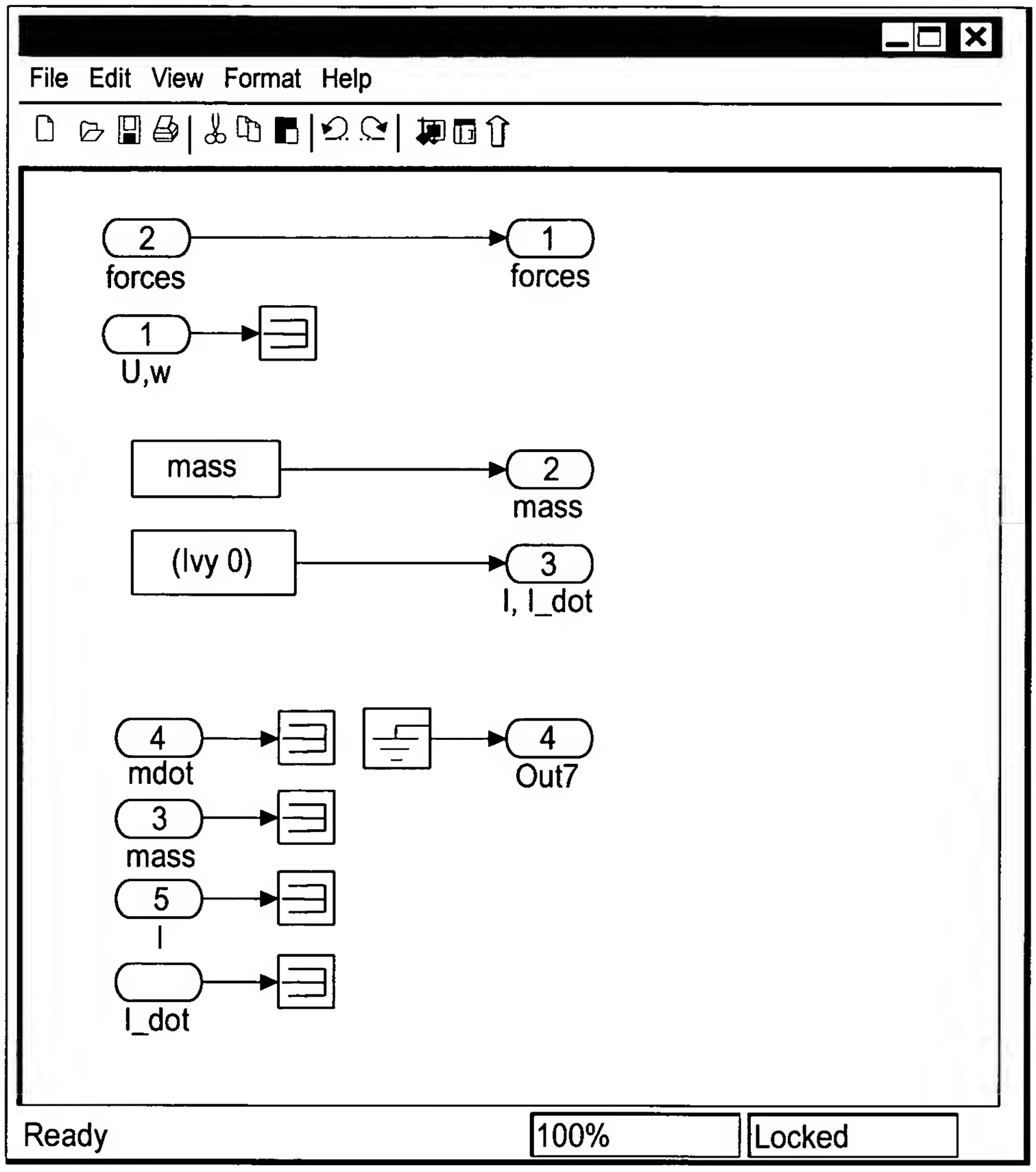
File Edit View Format Help
2
forces
1
forces
1
U,w
mass
2
mass
(Ivy 0)
3
I, I_dot
4
mdot
4
Out7
3
mass
5
I
I_dot
Ready
100%
Locked

Fig. 5C

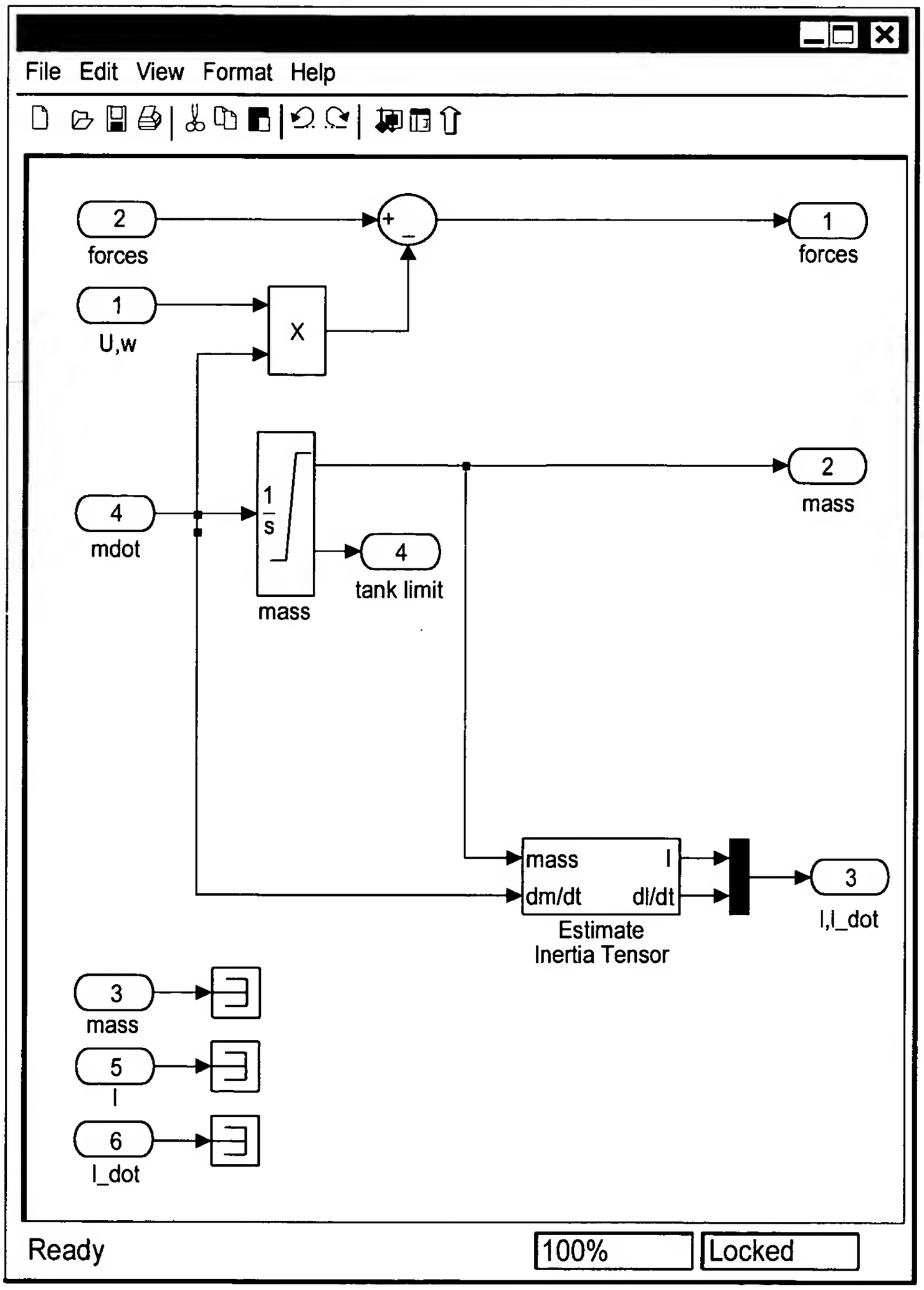
File Edit View Format Help
2
forces
1
forces
1
U,w
X
4
mdot
1/s
mass
4
tank limit
2
mass
mass
dm/dt
I
dI/dt
Estimate
Inertia Tensor
3
I,I_dot
3
mass
5
I
6
I_dot
Ready
100%
Locked

Fig. 5D

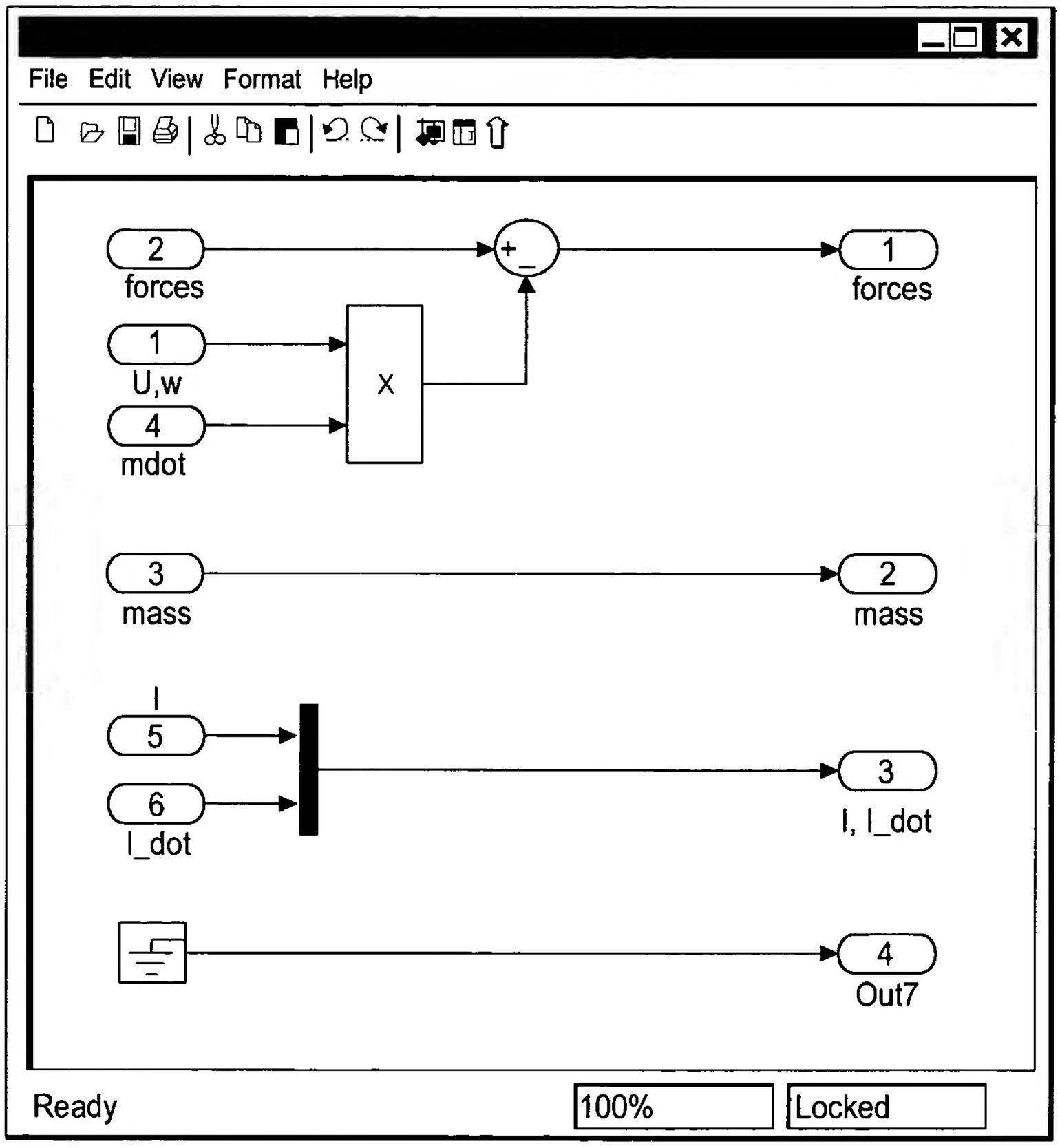
File Edit View Format Help
2
forces
1
U,w
4
mdot
X
+
_
1
forces
3
mass
2
mass
I
5
6
I_dot
3
I, I_dot
4
Out7
Ready
100%
Locked

Fig. 5E